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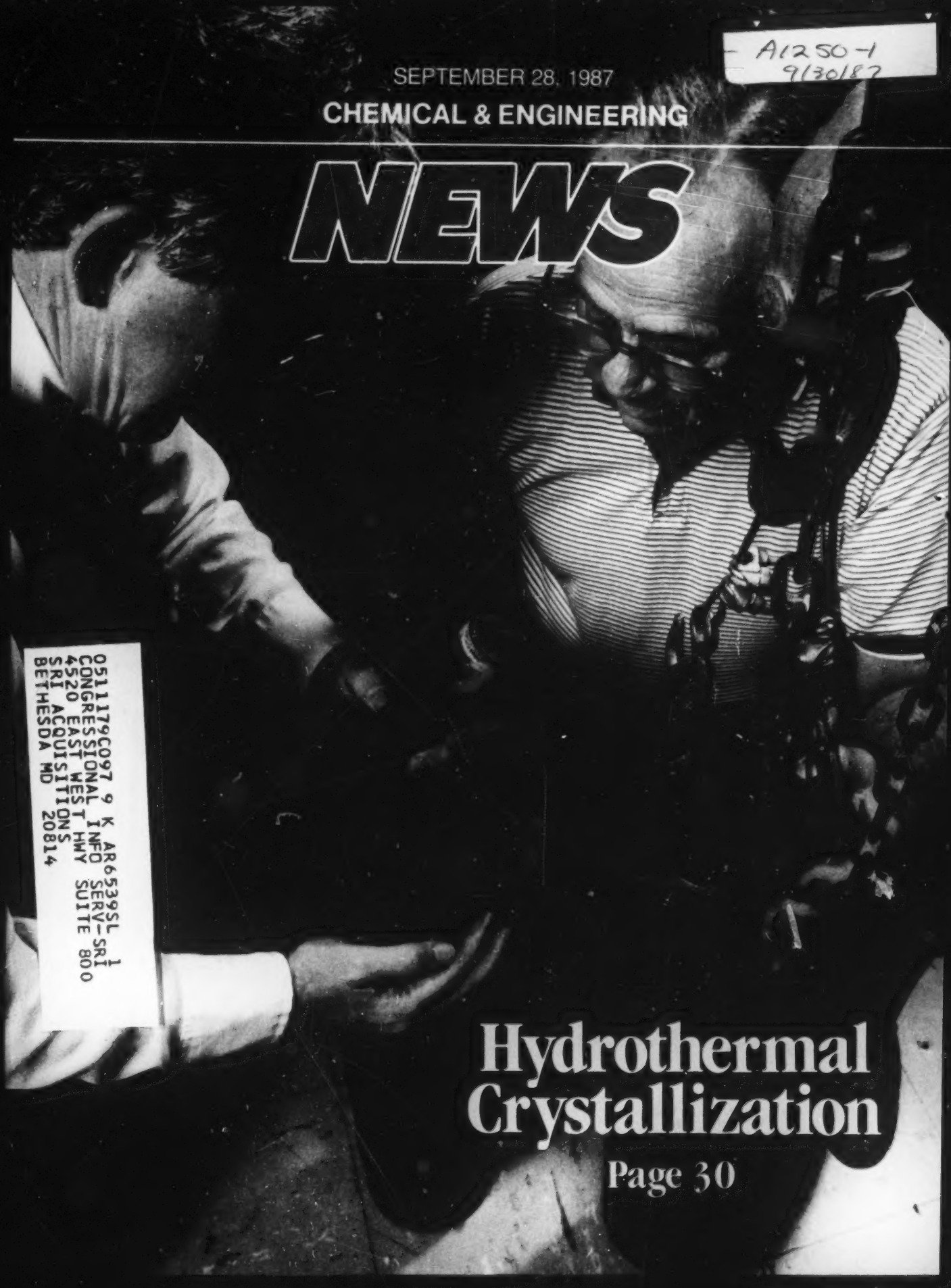
SEPTEMBER 28, 1987

CHEMICAL & ENGINEERING

NEWS



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Hydrothermal Crystallization

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CHEMICAL & ENGINEERING
NEWS
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News of the Week

■ **ICI sells Stauffer Chemical basic chemicals operations to Rhône-Poulenc for $522 million.** **Page 4**

■ **Test firing of space shuttle's redesigned solid rocket booster is a success.** **Page 5**

■ **New six-part science series, "The Ring of Truth," begins on PBS on Oct. 2.** **Page 5**

■ **House subcommittee hearing on AIDS elicits requests for funding, compassionate treatment.** **Page 5**

■ **Fraud in research was the topic of conference held by scientists, lawyers, and government and university officials.** **Page 6**

■ **House knocks $50 million off NSF's proposed budget for fiscal 1988.** **Page 6**

Cover: Two large hydrothermal autoclaves used for growing crystals at AT&T Bell Laboratories are examined by Robert A. Laudise (left) and Anthony J. Caporaso

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Business

Increased demand for ethylene, coupled with tightening supplies, allows producers to raise prices about 15%. **Page 9**

Makers of chlorinated solvents face dropping demand owing to pressure from regulatory and environmental groups. **Page 11**

Government

Schools—from universities to small town systems—are learning how to use and dispose of hazardous chemicals safely. **Page 15**

Proposed space station faces technological, financial, and management problems before it gets off the ground. **Page 16**

Interagency task force claims acid rain isn't harmful; environmentalists cry "propaganda" and Canada terms it "voodoo science." **Page 18**

Science

Cornell scientists use gas chromatography technique, and human volunteer sniffers, to quantitate odor-active substances in food. **Page 21**

A wide variety of alkane C-H bonds can now be activated by direct intermolecular insertion. **Page 23**

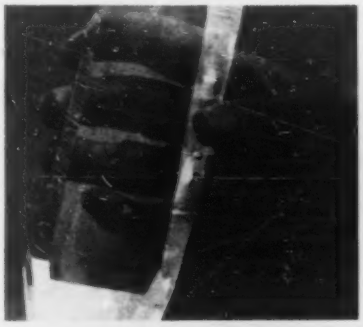
National Academy of Sciences report on superconductivity at high temperatures targets eight key research areas. **Page 23**

Education

Problems of Ph.D. candidates have been overlooked in the recent focus on the precollege student. **Page 24**

Technology

Sample preparation for chromatography; dimethyl carbonate synthesis; enzyme mimics of iron-zeolite; catalysts for alkane activation; electron hopping; mechanism for carbon oxide reduction; olefin epoxidation by electrochemical method. **Page 25**



Special Report

The electronic industry's growing need for crystals has been the impetus for accelerated research efforts in hydrothermal crystallization. **Page 30**

Tightening Supplies Push Up Ethylene Price

Price of monomer this month is forecast to be more than 15 cents per lb, up 15% from June, as increasing demand puts squeeze on supplies

Bruce F. Greek, C&EN Houston

This month control of ethylene marketing has shifted back to producers. Once again producers are setting prices after several years of buyers dictating what they will pay for the monomer. The change stems from tightened supplies of ethylene and other large-volume olefins and from the likelihood of tight supplies continuing, at least for the near term.

The change is evidenced by the large jump in ethylene price during the third quarter. In June, nearly all ethylene sold at about 13.5 cents per lb. The price in September is forecast to be 15.5 cents per lb, an increase of almost 15%. Additional price increases are predicted for the fourth quarter.

Until recently, buyers of ethylene based what they were willing to pay for the monomer on current tabs for the various possible feedstocks for steam crackers—ethane, propane, butane, condensate from natural gas production, naphthas, and gas oils. Despite firming of world crude oil prices this year, cracker feedstock prices have risen very little during the second and third quarters, because pressure has remained on natural gas prices. Some natural gas producers have closed down wells during the summer, rather than accept current offering prices. Moreover, relatively excessive supplies of gasoline during the summer have dampened the value of naphthas and gas oils to petroleum refiners, causing the intracompany transfer prices of these materials to hold.

Ethylene demand began increasing in late 1986, with much of the demand pressure coming from producers of polyethylenes, polyvinyl chloride, and polystyrene. In first-half 1987, production of low-density polyethylene rose 6.3%, high-density polyethylene rose 8.6%, polyvinyl chloride 8.0%, and polystyrene 10.3%, according to data from the Committee on Resin Statistics of the Society of the Plastics Industry.

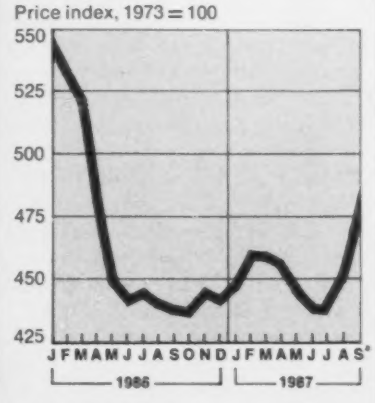
Producers of polypropylene also have increased their demand for propylene, a major coproduct of ethylene. This has added pressure to operate steam crackers at higher levels. It also has caused propylene prices to rise more than have ethylene prices.

Currently more than 75% of U.S. ethylene production eventually becomes components of polymers. Polyethylenes consume about 50% of ethylene output. Various linear olefins and alcohols and derivatives of ethylene oxide (excluding glycol in polyesters) are the larger volume uses of ethylene other than polymers.

Estimated production of ethylene during the first half of 1987 totaled 16.8 billion lb, according to the U.S. International Trade Commission. If annual production amounts to 33.7 billion lb, the industry will operate at more than 95% of average nameplate capacity, which is about 35.2 billion lb of ethylene in 1987. According to the preliminary ITC estimate, more than 32.8 billion lb of ethylene was produced in 1986, when less capacity was available.

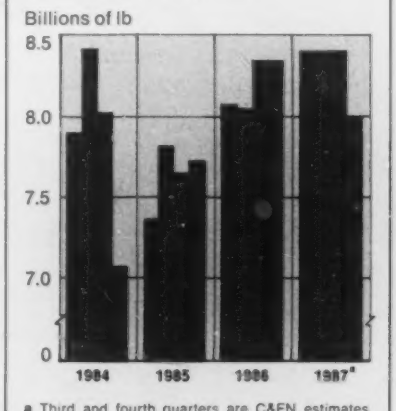
Consumption of ethylene could exceed production. The Petrochemicals Committee of the National Petroleum Refiners Association estimates that ethylene consumption for first-half 1987 totaled 17.2 billion lb. According to the NPRA committee, ethylene consumption for 1986 totaled 32.9 billion lb, which was very close to estimated production.

Price of ethylene has turned around



a C&EN estimate. **Source:** Department of Labor

Ethylene output may tail off later this year



a Third and fourth quarters are C&EN estimates.
Source: International Trade Commission

Production and consumption statistics aren't very reliable, so making an accurate estimate of ethylene inventory changes isn't possible. Inventories reported on surveys made by the NPRA committee for the end of 1986 and for the end of second-quarter 1987 are very nearly the same, 1.27 billion to 1.28 billion lb. (Inventories of ethylene in the 1.0 billion to 1.5 billion lb range are considered by the industry to be adequate compared with the 30 days of production inventories common to other chemicals.)

During the third quarter of 1987, industry sources indicate, producers were trying to build inventories in anticipation of shutdowns of several large steam crackers for maintenance work to begin late in September. More crackers are expected to be shut down during the first half of 1988 for similar work. Because of strong demand for ethylene by polymer producers, including a less-than-normal decline in PVC demand during the third quarter, various industry sources question the success of the inventory building efforts. Some shutdowns for maintenance in this quarter already have reduced production, but not so much as is anticipated for the fourth quarter. The price increases put through during the third quarter also provide evidence of limited success in inventory building efforts.

Three large steam crackers having a combined annual nameplate capacity of more than 4 billion lb of ethylene currently are planned to be shut down for three to six weeks each for maintenance and debottlenecking. That downtime likely will remove 400 million lb from production during the fourth quarter. The lost production could be larger should problems be encountered during restarting. Additional production could be lost if any of the remaining operating plants develop problems, which is somewhat more likely than usual because many plants have had maintenance shutdowns deferred to take advantage of improving demand.

More maintenance shutdowns are planned for the first half of 1988. The amount of ethylene production that could be lost in 1988 is uncertain now because all the plans for shutdowns may not be carried out. The quantities that may be lost are forecast to be smaller per quarter than those expected in the fourth quarter of 1987.

Various debottlenecking efforts by producers are offsetting production lost from maintenance shutdowns. Some of those efforts won't require plant shutdown—for example, improved computer process control, which will step up efficiency. Other efforts made on units that are running may have a small effect on production. Larger debottlenecks usually are made during shutdowns, and typically in 5 to 10% of the previous nameplate capacity of the steam cracker plant.

How much debottlenecking efforts will add to capacity is difficult to estimate. Company managements often are unsure of the amount until months have passed and the debottlenecking can be assessed. Industry sources estimate that debottlenecking during the first three quarters of 1987 has added 4 to 7%, or 150 million to 250 million lb, to operable capacity.

The capacity total for the U.S. ethylene industry now ranges from 35.2 billion to 35.4 billion lb, up from about 35.1 billion lb at the beginning of 1987. Another 100 million lb, possibly as much as 200 million lb of capacity, is expected to result from work done during the maintenance shutdowns of the upcoming quarter. Consequently, when 1988 opens, capacity will have risen to more than 35.5 billion lb, the highest in several years.

Demand growth for ethylene may continue to slow for at least a year, relative to growth so far this year. Part of the slowing will stem from limitations on availability resulting from the small capacity additions, and part will result from the now nearly full use of capacity in ethylene consuming plants. Polyethylene capacity, for example, will be increased, but these increases generally haven't taken place yet. Beginning with the fourth quarter, monthly gains in production and sales of ethylene-based plastics won't be so large as those in the fourth quarter of last year. Polyethylene price increases (C&EN, Sept. 7, page 16) have resulted from tightening in the supply of polymers and from the increases in monomer prices.

Industry sources do not expect the pressure on ethylene demand and subsequent price increases to be so great as those for other olefins produced in steam crackers. Propylene specifically has had large price increases this year, with polymer grade at the beginning of September selling for 18 cents per lb, up from about 10 cents per lb at the beginning of 1987. Demand for propylene has become so strong that this month the U.S. began to import the monomer; the U.S. had been a small exporter of propylene. In addition to limitations in propylene production in steam crackers (even though operators have shifted their feedstock composition toward increased propylene production), refinery sources are limited in capacity to purify propylene relative to demand.

Butadiene prices also have risen radically because of increased demand pressure and production and imports limitations. Last October, butadiene prices dropped to 9 cents a lb; demand in making styrene-butadiene rubber was weak. Now, with demand strong and both production and imports limited, butadiene prices are nearing 30 cents per lb. Because ethylene demand is so strong and economics now favor use of lighter hydrocarbons as feedstocks for steam crackers, the likelihood of any marked increase in butadiene production near term is small. ◻

Ethylene use dominated by polymers, polymer materials

Billions of lb	Consumption First-half 1987	% share
Low-density polyethylene	4.46	25.9%
High-density polyethylene	4.13	24.0
Ethylene oxide	2.56	14.9
Vinyl chloride	2.18	12.7
Ethylbenzene	1.23	7.1
Others	2.66	15.4
TOTAL	17.22	100.0%

Source: National Petroleum Refiners Association, Petrochemicals Committee

Chlorinated solvent use hurt by federal rules

The chlorinated solvents industry is coming under increased pressure from regulatory and environmental groups. And that pressure is causing declines in demand for the main chlorinated solvents—methylene chloride, trichloroethylene, perchloroethylene, and 1,1,1-trichloroethane.

The drop in demand doesn't mean necessarily that consumers of these products are using less, but rather that they are recycling more of the product. For instance, in the case of dry cleaning, because of new technologies, recycle rates now approach 98 to 99% for perchloroethylene, according to William Seitz, executive director, Neighborhood Cleaners Association. As a result, demand for perchloroethylene this year will be about that in 1980, he says. Seitz was speaking to a chlorinated solvents seminar, held in New York City earlier this month and sponsored by the Halogenated Solvents Industry Alliance (HSIA), a Washington, D.C.-based industry group.

U.S. demand for virgin solvents will be about 1.5 billion lb this year, according to R. Bradley Lienhart, chairman of the board of HSIA and business manager, solvents and industrial chlorides business, Dow Chemical. However, in addition to the 1.5 billion lb marketed for first-time use, 400 million lb of solvents are recycled "internally" by the user and another 260 million lb are recycled externally by service companies.

Lienhart says recycling accounts for most of the decline in growth in the chlorinated solvents industry, but other factors have contributed. These include a switch to aqueous solvents by some end users and also the loss of markets, particularly metal cleaning uses.

To allay further regulation of chlorinated solvents, HSIA has borrowed the "product stewardship" banner from Dow Chemical, one of its leading supporters. Lienhart says that producers, distributors, and users must initiate an "enhanced product and environmental stewardship" effort, bringing a commitment to use the solvents more safely and efficiently, and with a greater regard for the environment.

The effort involves communication and education in terms of product safety, worker safety, and technology available, he explains. There are, for instance, 200,000 dry cleaning establishments that use a drum or more of solvent per year. Though HSIA and the manufacturers may not be able to get the message downstream enough to cover all of these outlets, distributors can. The big distributors are getting into the program, he says.

Further, according to Lienhart, manufacturers are providing more technical service to customers in terms of plant operation and worker safety. Besides the "product stewardship" benefit, this approach can pay off in terms of increased value added for what are essentially commodity products. As with other commodities, however, the value-added approach is fraught with danger. Since the solvents are commodity products with no distinguishable differences from manufacturer to manufacturer, a user can switch to a lower-priced source after the solvent maker has provided it with technical assistance. To counter this, Lienhart says, all of the major solvent manufacturers must be involved and all must provide essentially the same service. All HSIA producer and distributor members, Lienhart adds, have their own variations of the enhanced product and environmental stewardship program.

William Storck, New York